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A NEW SPECIES OF WOLF SPIDER, *SCHIZOCOSA STRIDULANS* (ARANEAE, LYCOSIDAE)

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Abstract. *Schizocosa stridulans* new species is a sibling species to *S. ocreata* and *S. rovneri*. Both males and females of *S. stridulans* are very similar to males and females of *S. ocreata* and *S. rovneri* in coloration and genitalia, but are significantly smaller in carapace length and width. Mature males of *S. stridulans* lack a distinctive tuft of bristles on the tibia of the first pair of legs (present in mature males of *S. ocreata*, absent in mature males of *S. rovneri*); however, the tibia, patella and the distal 1/3 to 1/2 of the femur of legs I of males of *S. stridulans* are darkly pigmented. *S. stridulans* is found in mesic uplands leaf litter from Tennessee, Kentucky, Illinois, Ohio, Missouri, Mississippi, and Alabama, and sometimes co-occurs with *S. ocreata*. Male palps and female epigyna are figured for *S. stridulans* and for *S. rovneri* for the first time.

The genus *Schizocosa* Chamberlin consists of medium sized to large wolf spiders that are relatively strong legged and keen sighted. Members of this genus are characterized by conspicuous and contrasting light and dark bands on the carapace and abdomen, a distinct embolus and terminal apophysis in the palp of the male (Fig. 1), and an excavated transverse piece in the median septum in the epigynum of the female (Fig. 5) (Dondale & Redner 1978). *Schizocosa ocreata* (Hentz) is a member of this genus common throughout woodlands of the eastern United States. It is frequently called the brush-legged spider because of conspicuous tufts of black bristles and black pigmentation present on the tibia, patella and basitarsus of the first pair of legs in mature males (Fig. 11). In their revision of the genus, Dondale and Redner (1978) noted that there were occasional populations in which the tufts of bristles were reduced or absent. A form lacking tufts and black pigment on the first legs of mature males has a distinct courtship and is recognized as a distinct species (*Schizocosa rovneri* Uetz and Dondale 1979). *S. ocreata* and *S. rovneri* do not interbreed unless the female is anesthetized; thus, their differing courtship behavior serves as an isolating mechanism between the two species (Uetz & Denterlein 1979). Further studies by Stratton and Uetz (1981, 1983) demonstrated that the two species are interfertile when forced to mate.

A new species of *Schizocosa* is described and figured herein that is sibling to both *S. ocreata* and *S. rovneri*. Mature males of this new species lack the bristles on the first pair of legs, but do have conspicuous pigment on the distal 1/3 of the femur and on the tibia. While at first it was thought they may be hybrids between *S. ocreata* and *S. rovneri* (Dondale, pers. comm.), a comparison of the morphology and behavior of *ocreata- rovneri* hybrids (Stratton & Uetz 1983, 1986), with these clearly demonstrate that these forms are not hybrids but are a distinct species.

METHODS

The anatomical description of *S. stridulans* is based on mature males and mature females. Spiders collected as immatures were reared to maturity in the laboratory. Anatomical terminology follows that of Dondale and Redner (1978).

Scanning electron micrographs were done on a JEOL JSM T200 scanning electron microscope at 10 kv. Samples were prepared by cleaning ultrasonically for 3 min and then running samples through a dehydrating series of alcohol dilutions. They were air dried and mounted with silver paint on SEM stubs. Internal aspects of females were first cleared for 30 minutes in enzymatic solution (contact lens cleaner: 10 mg/10 mls distilled water), dehydrated in alcohol dilutions, then air dried and mounted.

In order to investigate patterns of co-occurrence and potential for overlap with related species, collections of *Schizocosa* were made in midwest and southern USA forests from March to July 1983-1986. Special emphasis was placed on collecting from floodplain forests along major rivers, and their corresponding uplands. Collec-

tions from the Mississippi State Museum and the Museum of Comparative Zoology were also examined. In all collections, mixed assemblages of species were noted.

Schizocosa stridulans, new species
Figs. 1, 5, 6, 13

Type Material.—Male holotype from Illinois, Mason Co., Sand Ridge State Forest, June 1985 (G. Stratton and L. Hartz), deposited at the Museum of Comparative Zoology (MCZ), Harvard University.

Etymology.—The species name refers to the primary method of sound production by males during courtship behavior.

Diagnosis.—*S. stridulans* is significantly smaller than either *S. ocreata* (as reported by Dondale & Redner 1978) or *S. rovneri* (as reported by Uetz & Dondale 1979; Table 1), although the overlap in sizes of these three species makes size an unreliable character (Table 1). Both males and females are indistinguishable anatomically from those of *S. ocreata* and *S. rovneri* except for the pattern of pigmentation on the first pair of legs of mature males. Both sexes key to *S. ocreata* in the key provided in Dondale and Redner's (1978) revision of the genus. Females can be confidently identified only when collected in association with males. In males of *S. stridulans*, the tibia, patella and distal 1/3 to 1/2 of the femur are black (Fig. 13). There are fine black hairs on the tibia of male *S. stridulans* distinct from the tibial tufts of bristles found in the mature male *S. ocreata* (Fig. 11). Mature males of *S. rovneri* lack both the tufts of bristles and the solid pigmentation on the tibia of legs I (Fig. 12), although these legs may be annulated. Males of *S. stridulans*, *S. rovneri* and *S. ocreata* are identical with respect to length and angle of paleal process of palp, median apophysis and with respect to rugose prominence along the retrolateral side of the paleal process (Figs. 1-3); this compares with the palp of *S. crassipes* (Fig. 4), a more southern species that has a smooth prominence along the retrolateral side of the paleal process. This last character corresponds with couplet #3, p. 147 in Dondale and Redner's (1978) key.

Mature females of *S. stridulans* have a slight darkening of the tibia, patella and basitarsus of legs I, as compared with their other legs. Females of *S. stridulans*, *S. rovneri* and *S. ocreata* all have paired excavations in the transverse piece of the median septum (Figs. 5, 7, 9). In each of these, the distance between the surface excavations is less than the width of one excavation. In females of *S. crassipes*, the distance between the excavations is greater than on the width of one excavation (refer to Dondale & Redner's key to females, couplet 5, p. 149 (1978)). Spermathecae of *S. stridulans*, *S. rovneri* and *S. ocreata* are illustrated in Figs. 6, 8, 10.

Males.—Total length, carapace length and carapace width as reported in Table 1. Carapace brown; pale submarginal band slender, usually distinct and undulating, rarely extending to carapace margins; pale median band as wide as posterior lateral eyes (mean 0.85 mm), with smooth margins and narrowing slightly in posterior third of carapace. Sternum yellow brown. Chelicerae brown, setaceous, with three uneven teeth on promargin of fang furrow and three even teeth on retromargin. Legs II to IV yellow with dark annulations particularly on femur and tibia. Femur of leg I with black pigmentation on distal half to third; tibia and patella of leg I usually uniformly black (rest of leg yellow) (Fig. 13). Pigmentation on femur sometimes streaked. Tibial brush in form of short black hairs that increase the apparent width of the tibia by about 0.2 mm (width of tibia: 0.54; width of tibia + hairs: 0.75; 15 specimens measured). Dark areas of leg I with the appearance of a "five-o-clock shadow". Dorsum of abdomen usually with heart mark (14 of 15 specimens), without chevrons. Cymbium of palp without terminal macrosetae but with concentration of bristles. Palea of palp with long distal process, and with a furrow marking off rugose prominence on retrolateral side. Median apophysis with distal margin convex and undulating. Intromittent part of embolus slender and pointed. Terminal apophysis with thickened margin concealing base of intromittent part of embolus (Fig. 1).

Females.—Total length, carapace length and carapace width as reported in Table I. Coloration similar to that of male but with the following

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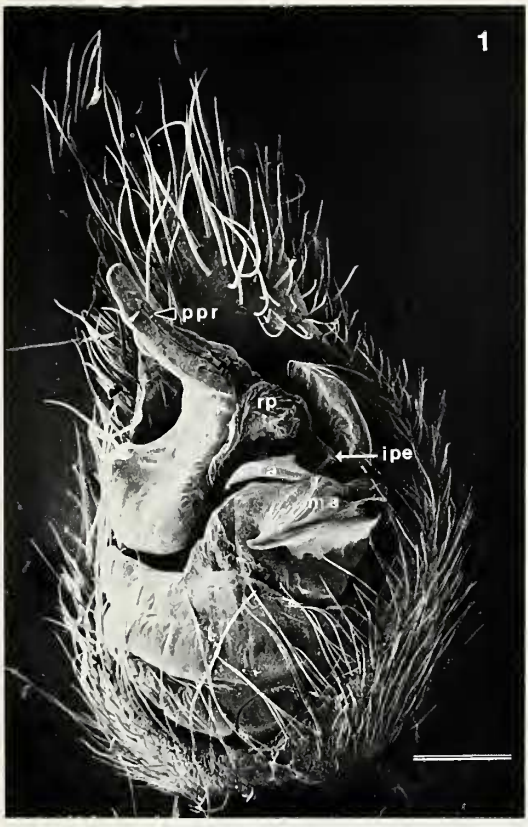
Figures 1-4.—Ventral aspect of left palp of *Schizocosa* species: 1, *S. stridulans*; 2, *S. rovneri*; 3, *S. ocreata*; 4, *S. crassipes*. ipe = intromittent portion of embolus; ma = median apophysis; ppr = paleal process; rp = rugose prominence; sp = smooth prominence; ta = terminal apophysis. Scale bars = 200 microns.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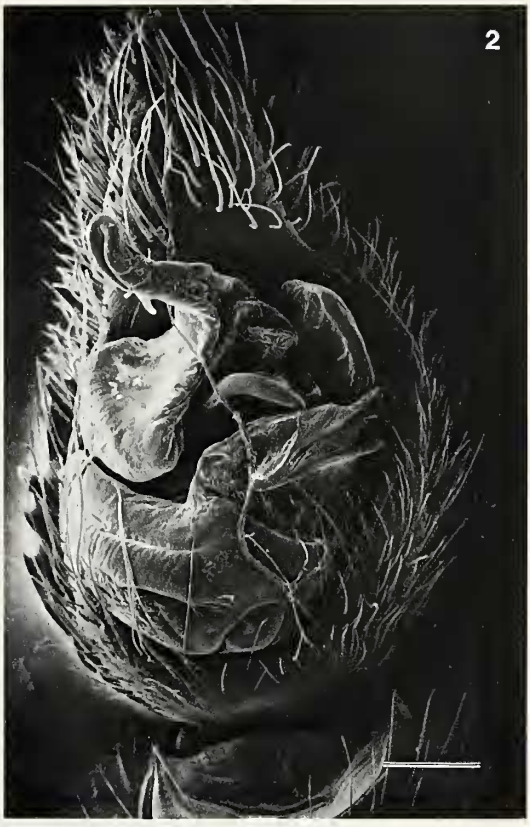
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Table 1.—Comparison of total length, carapace length and carapace width of *S. stridulans* n.sp., *S. ocreata* (data from Dondale & Redner 1978), and *S. rovneri* (data from Uetz & Dondale 1979). Measurements are in mm. Where sample size is greater than 10 individuals, carapace measurements are given as means ± their standard deviations. Values followed by the same letter are not significantly different from each other (1 tailed *t* test, $P < 0.05$).

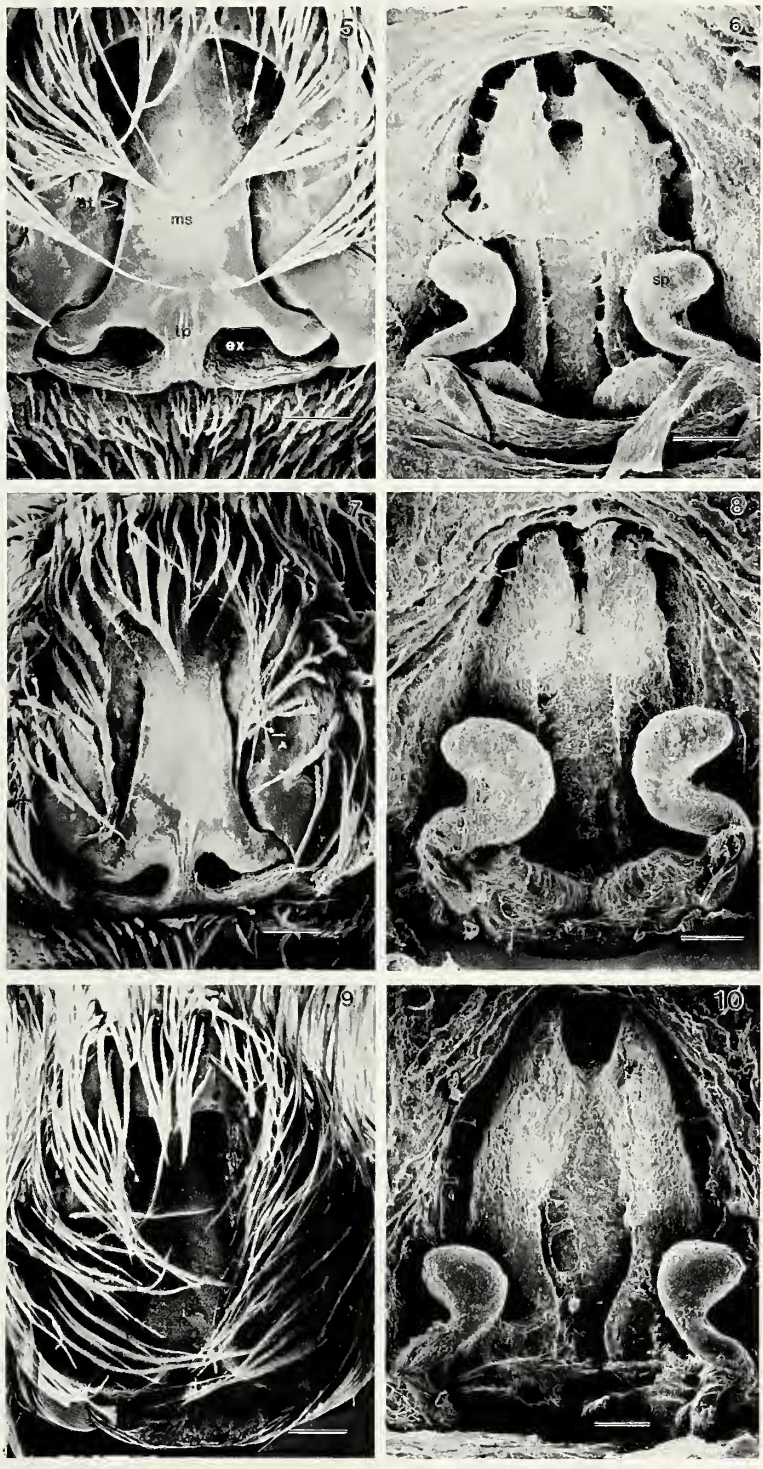
	S. ocreata	*S. rovneri*	*S. stridulans*
MALES			
Total length (ranges)	5.65–8.30	6.48–8.00	5.04–6.80
(mean)			6.40 ± 0.43
Carapace length (means)	3.65 ± 0.43 A	3.73 A	3.25 ± 0.33 B
(ranges)		3.48–4.02	2.47–3.80
Carapace width (means)	2.78 ± 0.34 C	2.77 C	2.56 ± 0.24 D
(ranges)		2.57–2.95	2.04–3.10
Sample size	20	7	51
FEMALES			
Total length (ranges)	7.30–10.40	6.01–7.95	6.56–11.36
(means)			8.09 ± 1.21
Carapace length (means)	4.00 ± 0.43 E	3.91 E	3.50 ± 0.40 F
(ranges)		3.45–4.28	2.63–4.27
Carapace width (means)	3.02 ± 0.31 G	2.93 G	2.68 ± 0.35 H
(ranges)		2.64–3.24	1.88–3.21
Sample size	20	7	61

exceptions. Pale median band on prosoma 0.96 mm wide behind eyes and usually narrowed in posterior half of carapace. Chelicerae as in male. Legs I to IV yellow with dark annulations. Tibia, basitarsus and occasionally patella of leg I darker than on other legs, with annulations less distinct. Epigynum with moderately deep atrium; median septum with longitudinal piece broad posteriorly and usually narrowing anteriorly with lateral edges concave. Transverse piece with large paired excavations, these excavations nearly meeting at midline. In 7 of 15 individuals, these excavations asymmetrical in size and sometimes in shape. Distance between excavations varying from almost no space to a separation slightly less than the width of a single excavation. Spermathecae ovoid, smooth, separated by approximately their width.

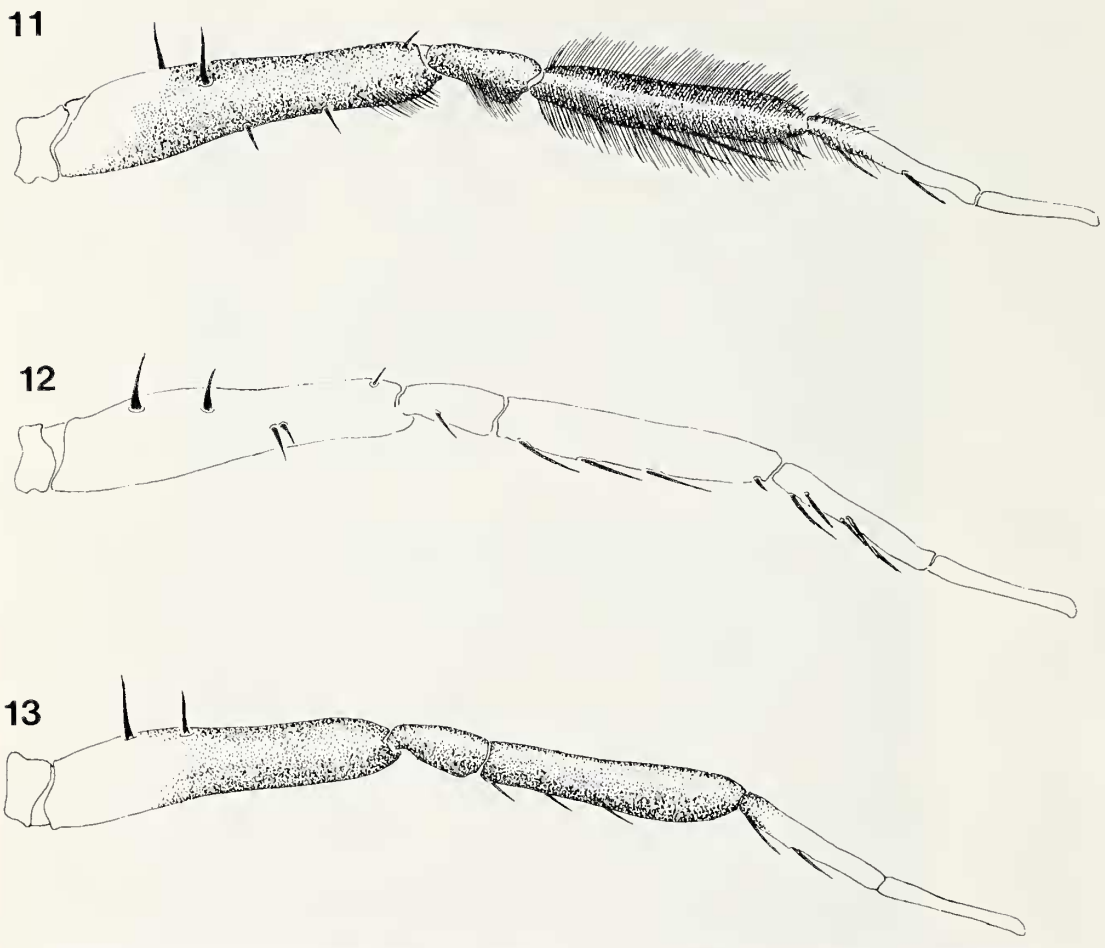
Courtship behavior.—Males of *S. stridulans* clearly differ from *S. ocreata* and *S. rovneri* in sexual behavior. The courtship of *S. stridulans* consists of pulses of stridulation of the palp, interspersed with tapping of the first pair of legs. A full description of the courtship behavior, the sounds produced during courtship, the variability of the various components of the behavior, and the results of attempted cross matings is in preparation (Stratton, in prep.). Males of *S. stridulans* will rarely court females of either *S. ocreata* or *S. rovneri*. Females of the other species are not receptive to courting males of *S. stridulans*. Females of *S. stridulans* are not receptive to courting males of other species.

Geographic distribution and habitat.—Collections of *S. stridulans* have been made from southern Ohio, Illinois, Kentucky, Tennessee, Missouri, Alabama and Mississippi (Fig. 14), thus giving it broad geographic overlap with both *S. rovneri* and *S. ocreata*. The habitat of *S. stridulans* is mesic uplands leaf litter, typically in oak forests or oak hickory forests (Fig. 16). The present study also extends the known range of *S. rovneri*.

In two of eight localities visited in 1984 and 1985, *S. stridulans* was the only *Schizocosa* collected in the uplands forests (Figs. 15, 16). In three collections, *S. stridulans* occurred in the same habitat as *S. ocreata* (Figs. 15, 16), and in one collection from Alabama it also occurred with a population that is possibly an undescribed species within this species complex (Stratton unpubl. data). Table 2 summarizes 46 collections of *Schizocosa* and indicates whether species were collected alone, or co-occurred with other species in the species group which includes *S. ocreata*, *S. rovneri*, *S. stridulans* and the southern species



Figures 5-10.—External and internal aspects of epigyna of *Schizocosa*: 5, external aspect of *S. stridulans*; 7, external aspect *S. rovneri*; 9, external aspect *S. ocreata*; 6, spermatheca of *S. stridulans*; 8, spermatheca of *S. rovneri*; 10, spermatheca of *S. ocreata*. at = atrium; ex = excavation; ms = median septum; tp = transverse piece. Scale bars = 100 microns.



Figures 11-13.—Legs I of mature males of *Schizocosa*: 11, *S. ocreata*; 12, *S. rovneri*; 13, *S. stridulans*.

S. crassipes and *S. floridana*. In most collections each of these species was found alone, although *S. ocreata* and *S. rovneri* sometimes co-occurred as did *S. ocreata* and *S. stridulans*. This suggests that for the species that do co-occur, courtship behavior is potentially important as an isolating mechanism. This has been studied extensively for *S. ocreata* and *S. rovneri* (Stratton & Uetz 1981, 1983, 1986) but to a more limited extent in *S. stridulans* and *S. ocreata* (Stratton, in prep).

Table 2.—Co-occurrence of species within the *Schizocosa ocreata* species complex. Each entry represents a separate collection. Collections were by the author, by Wayne Maddison and from the Mississippi State Museum.

	S. ocreata	*S. rovneri*	*S. stridulans*	*S. crassipes*	*S. floridana*
S. ocreata	13				
S. rovneri	3	12			
S. stridulans	3	0	6		
S. crassipes	1	1	1	4	
S. floridana	0	0	0	1	1

More is known of the habitat preferences for *S. ocreata* than for the other species in the genus, and this preference appears to vary geographically. Dondale and Redner (1978) report that *S. ocreata* tend to be found in moist areas relative to *S. crassipes* and *S. floridana*. In North and South Carolina, Missouri (Big Oak Tree State Park), as well as in Sand Ridge State Forest in central Illinois, *S. ocreata* was collected on the floodplains of rivers or near wet areas. For example, along the flood plain of the Tyger River in S. Carolina, *S. ocreata* appeared to be the most abundant wolf spider; in Big Oak Tree State Park, a virgin floodplain forest along the Mississippi River in Missouri, *S. ocreata* again appeared to

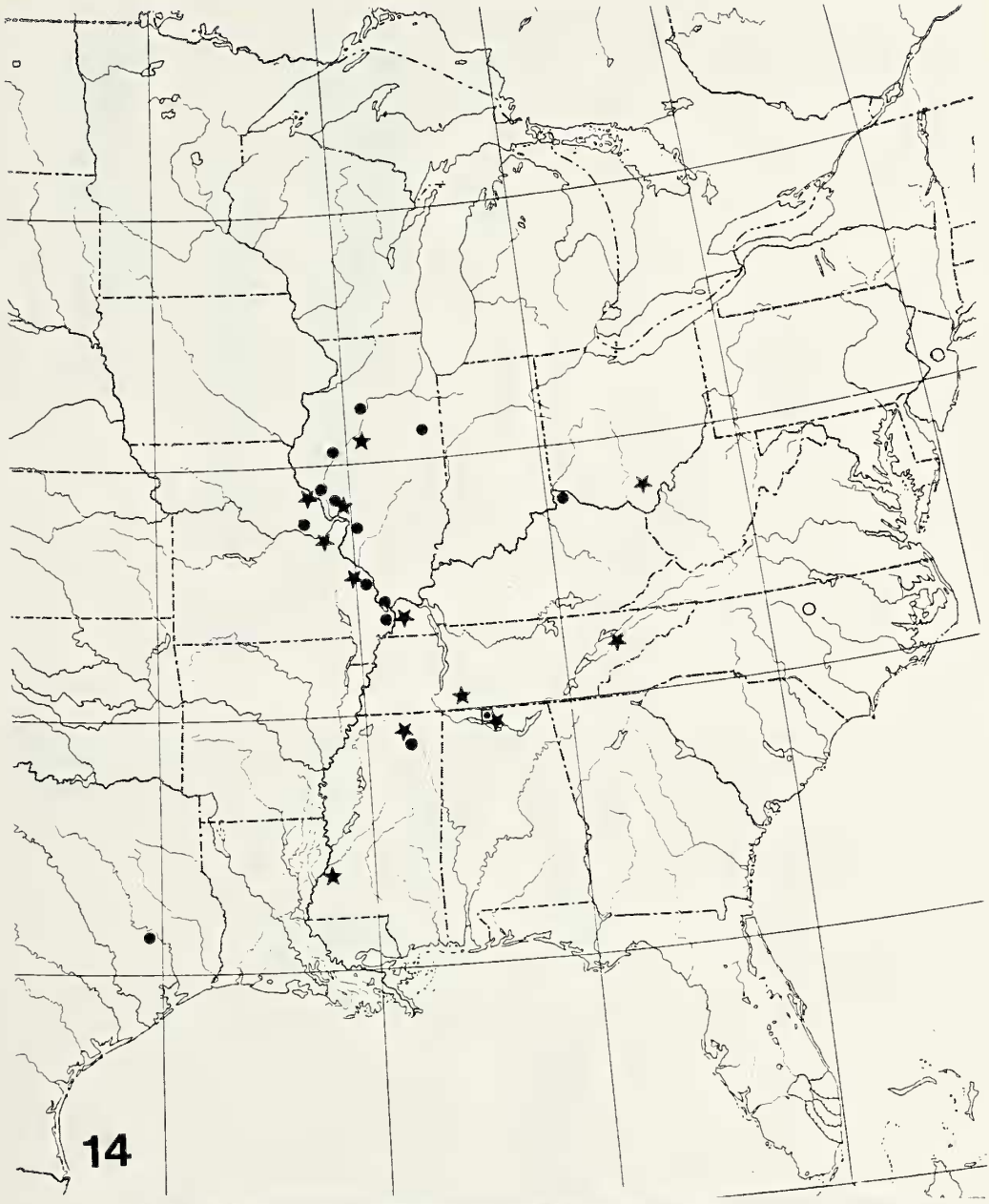


Figure 14.—Distribution of *S. stridulans* n. sp. (star) and *S. rovneri* (solid circle).

be the most abundant wolf spider (Fig. 17). Collections in Illinois, Kentucky, and Ohio yielded *S. ocreata* from the drier uplands and often on slopes above major rivers (Fig. 16), while other species (particularly *S. rovneri*) were found on floodplains and bottomlands (Fig. 17). Perhaps the habitat "preference" of *S. ocreata* may partially depend on geographic locality (and its many associated factors) and/or possibly on the presence or absence of other competing species. Cady (1983) in a study in south central Ohio, reports that *S. ocreata* is closely restricted in its microhabitat and that its distribution and locomotor activity are related to moisture and physical features of the microhabitat. Cady found that *S. ocreata* was more likely to be found in full leaf litter rather than in sparse litter, and that the species preferred areas of high soil moisture. He

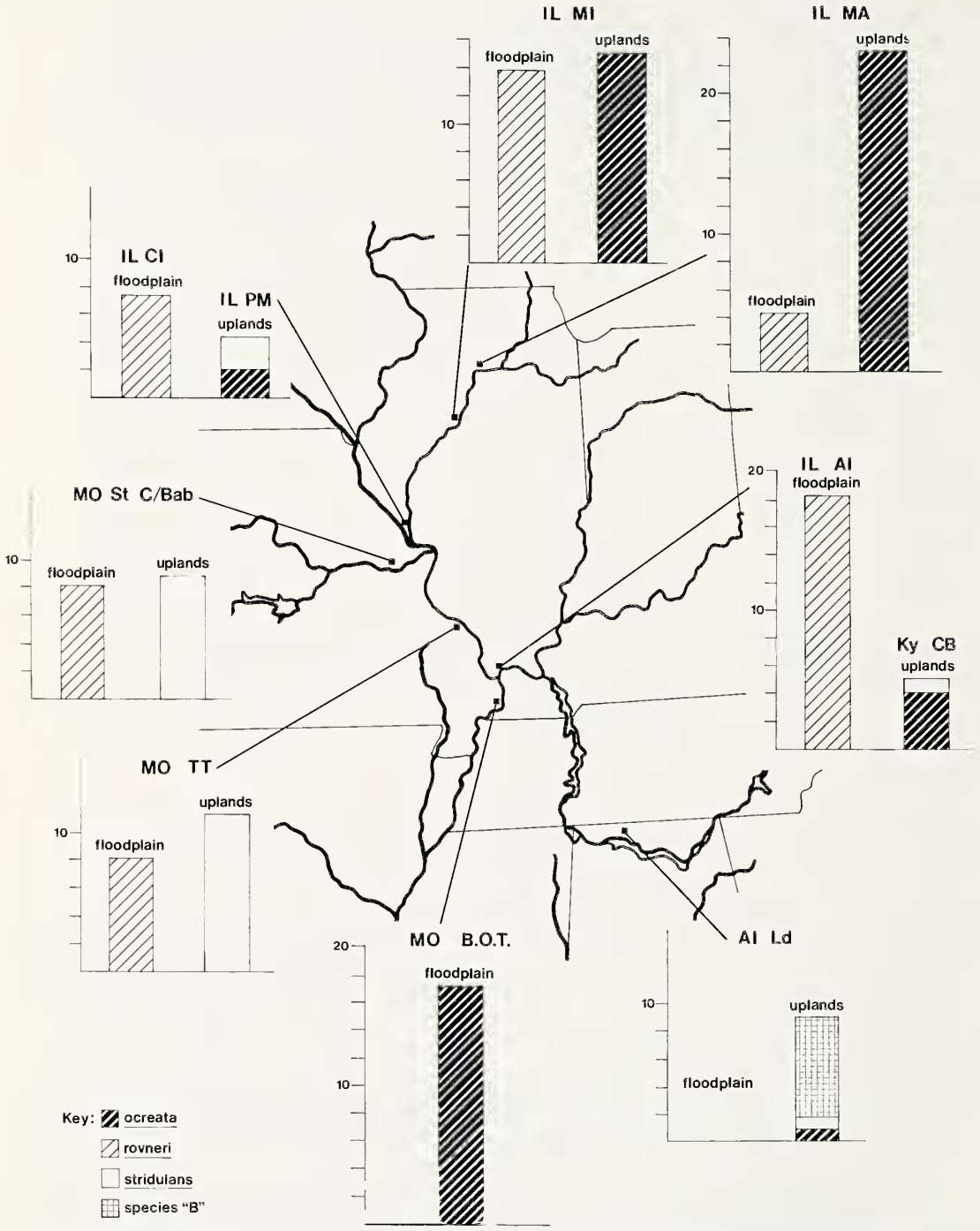


Figure 15.—Comparison of relative numbers of *S. stridulans* n. sp. and related species in floodplain forest and uplands forest along major river systems in the U.S. Midwest. The X-axis of each graph shows numbers of spiders collected/person-hour (most collections were 2-3 person-hours). Collections were done by the author in 1984 and 1985. From top and clockwise: IL MI = Illinois: Marshall Co., State Fish and Wildlife Area; IL MA = Illinois: Bureau Co., Miller Anderson Nature Preserve; IL AL = Illinois: Alexander Co.; KY CB = Kentucky: Hickman Co., Columbus-Belmont Battlefield State Park; AL Ld = Alabama: Lauderdale Co. (along Tennessee River); MO B.O.T. = Missouri: Mississippi Co., Big Oak Tree State Park; MO TT = Missouri: Cape

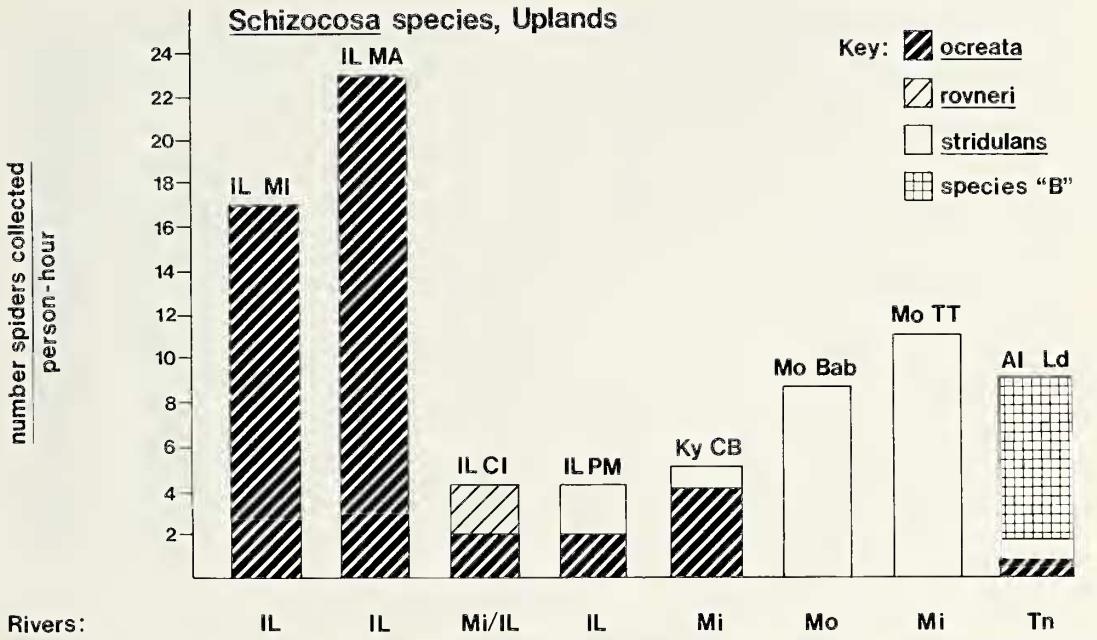


Figure 16.—Comparison of relative numbers of *Schizocosa* species collected from uplands habitat. Key as in Fig. 15.

suggests that microhabitat selection by *S. ocreata* is important in courtship.

The habitat of *S. rovneri* is generally floodplain forests (Uetz & Dondale 1979; Stratton & Uetz 1981, and Fig. 17), although there are reported collections of *S. rovneri* from several upland habitats in the Cincinnati area (G. W. Uetz, pers. comm.) and in Illinois (Fig. 16). The spiders are most frequently found in or on flattened mud packed leaf litter, or in and on piles of drift that are frequently found in these flood prone ecosystems.

In Central Illinois (Mason County), *S. ocreata*, *S. rovneri* and *S. stridulans* were all found in close proximity to each other. *S. rovneri* was found in the Chautauqua National Wildlife Refuge, along the Illinois River. It was also collected in other floodplain forests along the Illinois River. A population of *S. ocreata* was found in a swampy area within the Sand Ridge State Forest. An adjacent area that was slightly higher in elevation and slightly more mesic yielded *S. stridulans*. These populations and their habitats were investigated in some detail and will be reported separately (Stratton, in prep).

The distribution patterns within this complex of three sibling species are intriguing. While *S. ocreata* and *S. rovneri* are sympatric and occasionally syntopic, and while *S. ocreata* and *S. stridulans* are also occasionally syntopic, *S. stridulans* and *S. rovneri* are apparently never syntopic. It appears that both *S. rovneri* and *S. stridulans* are stenotypic, whereas *S. ocreata* is comparatively eurytypic. More investigations with the detail of Cady's (1983) study are needed to understand the interaction of these spiders with their habitat.

It appears that courtship behavior of these species may be very habitat specific. It is hypothesized that the stridulatory component of the courtship behavior in *S. stridulans* may be inaudible (and ineffective) on anything but dry leaves. The courtship behavior of *S. stridulans* is most similar to that of *S. crassipes* and *S.*

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Girardeau Co., Trail of Tears State Park; MO St C/Bab = Missouri: St. Louis Co., Babler State Park; IL Cl = Illinois: Calhoun Co., Reds Landing Waterfowl Management Area; IL PM = Illinois: Jersey Co., Pere Marquette State Park.

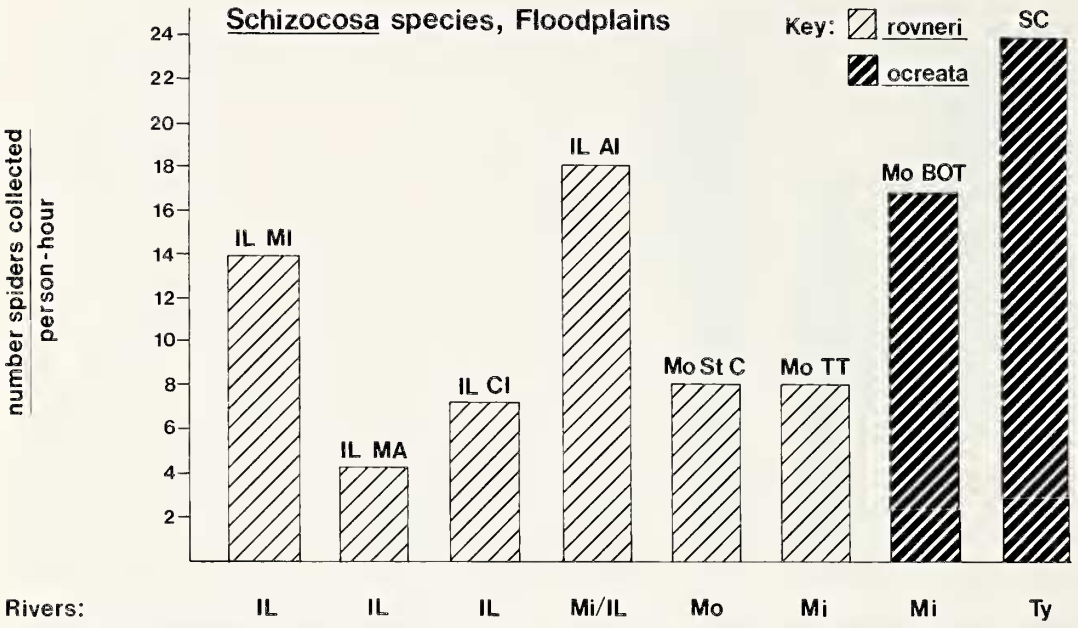

Figure 17.—Comparison of relative numbers of *Schizocosa* species collected from floodplain habitats. Key as in Fig. 15.

floridana (Stratton in prep), both of which are also restricted to mesic habitats (Dondale & Redner 1978; Stratton, unpubl. data). Through this study and others, a more complete understanding of *Schizocosa stridulans* will contribute to our understanding of the evolution of this genus.

Material examined.—USA: *Illinios*: Mason Co., Sand Ridge State Forest, May-June 1985 (G. Stratton and L. Hartz), 15 males, 15 females (MCZ); Jersey Co., Pere Marquette State Park, 29 May 1984 (G. Stratton, L. Williams), 4 males (GES). *Ohio*: Athens Co., Strouds Run State Park, June 1986 (J. Rovner), 1 male (GES). *Missouri*: St Louis Co., Babler State Park, 1 June 1984 (G. Stratton, L. Williams), 10 males (GES); Cape Girardeau Co., Trail of Tears State Park, Oak Forest Uplands, 25 June 1984 (G. Stratton and L. Williams), 18 males, 11 females (MCZ). *Tennessee*: Lawrence Co., Davy Crockett State Park, ravine slope, 16 May 1983 (W. P. Maddison), 9 males, 7 females (MCZ); Knox Co., near Powell, oak forest, 23, 30 June 1981 (G. Stratton), 5 males, 12 females (MCZ). *Kentucky*: Rowan Co., Daniel Boone National Forest, Twin Knob Recreation Area, 14 May 1983 (W. P. Maddison), 4 males, 3 females (MCZ); Hickman Co., Columbus Belmont Battle Field State Park, 3 June 1984 (G. Stratton, L. Williams) 1 male (GES). *Alabama*: Lauderdale Co., above Tennessee River, 18 June 1984 (G. Stratton, L. Williams), 1 male, 1 female (GES). *Mississippi*: Pontotoc Co., Natchez Trace Parkway, 17 May 1983 (W. P. Maddison), 4 females (MCZ), 1 mi. SE of Ecru, pitfall in deciduous forests May-June 1980 (W. H. Cross), 7 males (MSM); Claiborne Co., Rocky Springs Park, 17 May 1983 (W. P. Maddison), 5 males, 6 females (MCZ). (Note: MCZ refers to Museum of Comparative Zoology, Harvard University, MSM to Mississippi State Museum, and GES to the personal collection of the author.)

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